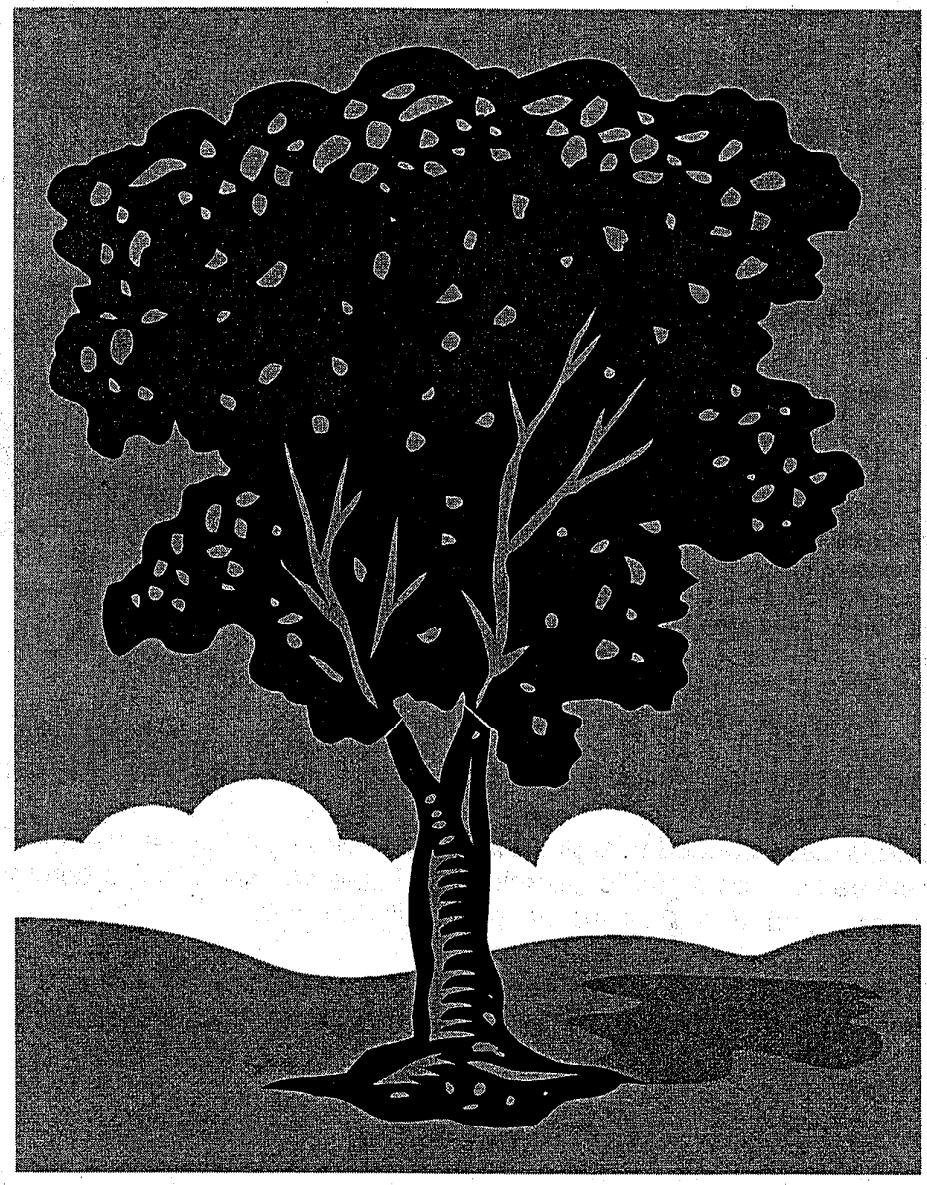
Miami-Dade County Guide to Tree Planting and Maintenance in The Public Right-of-Way



Introduction

Tree Planting in the Public Right-of Way in is a Guide to selecting, placing, protecting, maintaining trees in the County Right-of-Way (ROW). ROW's are found along roadways, in swales, and adjacent to homes and businesses. A healthy, functional, and attractive tree growing in any one of these locations provides benefits not only to the property owner, but to the surrounding community as well.

The following practices are the technically correct and widely accepted *practices* and *standards* used by professional arborists, urban and community foresters, landscape architects, and other tree care and landscape professionals. The goal of this guide is to provide you with basic and practical information on how to best accomplish the most important tree management activities.

Who Should Use This Guide

If you are a—

- **Dade County Resident**
- **Government Official or Staff Member**
- **Construction Contractor or Employee**
- **Engineer**
- **Heavy Equipment Operator**
- **Land Developer**
- **Landscape Architect**
- **Landscape Maintenance Contractor or Employee**
- **Neighborhood Association**
- **Planner**
- **Tree Care Service Contractor or Employee**

--then this Guide is for you! *Your* implementation of the practices in this guide is an important component of our overall community tree management program.

This Guide is also intended to support the Miami-Dade County Landscape Code, and should be used as a project planning and implementation tool, a community education tool, and as a standard for community tree care.

This Planting Guide is just one part of a Countywide *Tree Health Program*. This Program includes an ongoing *tree inventory*, a comprehensive *tree planting and maintenance program* of over 80,000 County installed trees within the Public Right of Way.

Section 1: Tree Basics

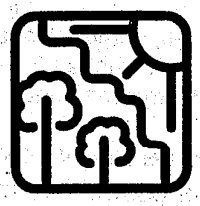
The Benefits of Trees

Trees provide you, and our community, with many environmental, social, and economic benefits. Many of these benefits are tangible and measurable. Some of the more important benefits are highlighted below:

Trees improve air quality.

- ★ Their leaves absorb carbon dioxide (the primary "global warming" gas) during the process of photosynthesis, and produce the oxygen we need to breathe.
- ★ Tree leaves also absorb other pollutants and particulate matter from the air.
- ★ A large, healthy tree can produce enough oxygen each day for 18 people.
- ★ Trees reduce pollution and absorb carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulates.
- ★ Trees can remove up to 13% of particulates in the air.
- ★ By providing a cool, shady spot for us to park our cars, trees also reduce the amount of volatile organic compounds (VOC's) that are released from them. In the sun and heat, parked cars continue to release VOC's from the gas tank, so tree canopy can significantly reduces the level of emissions.

Trees save energy.

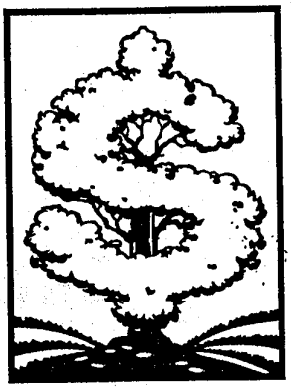


- ★ They shade our homes and offices, and the streets, parking lots, and other pavement that surrounds them.
- ★ They cool the air as their leaves evaporate water.
- ★ Leafy green tree crowns create a canopy of shade, reducing the amount of sunlight reaching our streets, lawns, and parking areas, resulting in lower summer temperatures.

Trees reduce storm water runoff.

- ★ Their leaves and branches intercept rainfall and release it slowly, thereby reducing runoff and helping to maintain water quality.
- ★ The many leaves, branches, and stems of trees intercept rainwater, hold it, and then release it slowly so that it can be absorbed by the soil.
- ★ Tree roots also actively remove water from the soil.
- ★ The amount of overland flow of water and non-point source pollution that occurs during and after heavy rains is decreased by trees.

Trees increase property values and make communities more appealing



The Cost of Trees

While trees provide us with many benefits and are a valuable community asset, there are costs associated with their conservation, establishment, and maintenance.

Trees cost money to establish, maintain, and protect.

- Good quality planting stock is expensive, but by purchasing good quality trees, future replacement and maintenance costs can be reduced.
- Tree maintenance, especially pruning, must be done regularly to insure tree health, safety, and longevity.
- Trees must be constantly monitored and protected from damage that may result from construction activities, utility line installation or repair, and pest problems.
- When trees decline beyond the point of improvement or when they die they require removal, which can be expensive for large trees.

Trees can grow larger than expected and may outgrow the space available.

- When tree branches grow into clear zones for utility lines, pedestrian walkways, buildings, streets, and vehicle and equipment travel lanes they reduce clearance and sight distance and cause increased costs to maintain public safety.
- Without adequate growing space, trees will not achieve their potential for size, health, and longevity and will require more maintenance and will need to be replaced more often.

Trees can be hazardous.

- Many trees, either today or in the future, tower over our property and us. When whole trees or their parts fail and fall, they can cause utility service outages, damage to vehicles, homes, fences, and pavement, and personal injury.
- Tree roots that surface above ground can be a tripping hazard, and can cause damage to lawn mower blades. Trees left unpruned over walkways can cause personal injury.

While there are many costs associated with trees, in most cases the benefits far outweigh the costs. The ratio of benefits to costs can be much improved with the implementation of the practices in this guide.

Tree Structure

A **tree** is defined as a woody plant that grows to 12 or more feet in height, usually with a single trunk, growing to more than 3 inches in diameter at maturity, and possessing an upright arrangement of branches and leaves. Trees are commonly referred to by their size, specifically their *mature* height. In this Guide, tree heights are divided into **small**, **medium**, or **large** height classes and are defined as follows:

Small Trees: Less than 25 feet tall at maturity
Medium Trees: 25 to 40 feet tall at maturity
Large Trees: 40 to 100 feet tall or more at maturity

Trees, like people, are complex living organisms made up of many types of cells arranged into tissues and organs. Unlike people, they are only generating systems, and cannot regenerate new cells in the place of damaged or destroyed cells. Because trees generate new wood as they grow, they can get to be very large and achieve a huge volume (size) and mass (weight).

The three main parts of a tree are its **crown**, **trunk**, and **roots**.

The **crown** is the woody and leafy component of the tree. It is composed of large, scaffold limbs that support smaller branches, twigs, leaves, and buds. The leaves absorb carbon dioxide and in the presence of sunlight produce food—carbohydrates—in a process called photosynthesis. As a by-product, the trees leaves produce and release oxygen. Tree growth occurs at the tips of the branches, which can extend a few inches to several feet a year, depending upon the species and growing conditions. Tree crown size is measured as diameter in feet of the width of the branches at their greatest extent.

The horizontal projection of the tree crown onto the ground or the square foot area the crown covers is defined as the tree **canopy**. Tree canopy cover is calculated by multiplying the width of the crown in the north-south direction by the width of the crown in the east-west direction. For example, a tree with a crown width of 40 feet in the N-S direction and a width of 30 feet in the E-W direction has a canopy cover area of 1200 square feet. Estimates of mature crown canopy size categories for trees growing in urban areas are as follows:

Very Small Canopy: 150 square feet (approximately 12 x 12 feet)
Small Canopy: 400 square feet (20 x 20 feet)
Medium Canopy: 900 square feet (30 x 30 feet)
Large Canopy: 1600 square feet (40 x 40 feet)

The **trunk** is the main woody stem of the tree and supports the crown. While most trees normally have one stem or trunk, other trees are characteristically multi-stemmed.
Carbohydrates and other substances necessary for tree growth are stored in the trunk, roots, and other woody portions of the tree. Water is transported up through the trunk to other parts of the tree. Tree size is often measured as **dbh** or "*d*iameter at *b*reast *h*eight" which is the diameter of the trunk at 4.5 feet above ground. For a tree forked at or below 4.5 feet, diameter is the sum of all the trunks at 4.5 feet above the ground.

You can calculate trunk diameter by measuring trunk circumference at 4.5 feet above the ground with a standard tape measure and dividing by pi or 3.14, a constant.

Diameter = Circumference ÷ 3.14

Beneath the **bark**—the outer protective layer that covers the trunk, limbs, branches, and

roots—there is a very thin layer of specialized cells known as the **cambium layer**. The cambium layer is where growth in trunk and root diameter takes place each year when both a layer of wood (xylem) is produced to the inside, and a layer of inner bark (phloem) and bark are produced to the outside. The cambium layer functions as the food transport system for the tree.

The **roots** are the underground structures that anchor the tree and absorb water and nutrients essential for tree survival and growth. The anchoring roots are large, ropelike, and woody and usually number from 4 to 11.
Tree roots grow out from the trunk for a distance of at least 2 to 3 times the radius of the tree's crown, or at least 2 times the height of the tree.
However, they taper rapidly as they move away from the tree trunk. While the large roots grow out from the tree trunk, many small, fibrous absorbing roots arise from the woody roots and generally grow *up* and into the top layers of soil and leaf litter—layers rich in organic material. Attached to the fine root hairs on fibrous roots are beneficial fungi that combine with the root hairs to form **mycorrhizae**, structures of benefit to both the fungus and the tree. These structures increase the surface area that absorbs water and nutrients.
85% of a tree's roots are located in the top 18 inches of soil.

Tree Growth

Trees require a certain amount of basic substances and a specific combination of environmental conditions to function, survive and grow. Each individual tree species, like all plant species, has a *range* of soil moisture, soil volume, soil nutrient and acidity levels, air temperature, humidity, and sunlight in which it will grow. Under optimal conditions, trees will achieve their genetic potential for size, age, and form characteristic of their species. Under less than optimal conditions, trees will grow slower, be smaller at maturity, become easily stressed, have more deadwood, and will be more vulnerable to attacks by insects and disease organisms. As stated earlier, trees cannot regenerate or replace cells damaged or destroyed with new cells in the same location.

Because trees can only "seal" their wounds and cannot "heal" their wounds, any physical damage done to a tree's roots, trunk, or crown affects it for the rest of its life.

This is important to understand before we cut or damage a tree's roots, wound its trunk, break its limbs, or prune it incorrectly. The amount of energy that a tree is able to store has an effect on its ability to withstand unfavorable conditions and resist attacks by insects, fungi, bacteria, and other harmful organisms. This energy storage capacity is an important factor to consider when working around trees. Trees most affected by injury or stresses are those that store little energy, are fast growing, have inadequate soil volume and growing space, have been adversely affected by weather conditions, have been repeatedly wounded, or are at a critical point in their seasonal or life stage development.

The Critical Root Zone and Tree Protection Zone

Because trees contribute so much to our quality of life, they must be actively conserved, wisely selected, well placed, well planted, routinely maintained, and constantly protected. One of the most critical steps in planning for trees and cost effective ways of managing trees is to maintain adequate growing space for each tree's roots, trunk, and crown *throughout the tree's life.*

Remember that as a tree gets older it gets larger and the growing space it requires increases accordingly.

For existing trees, there is a minimum amount of area, above (for the trunk and crown) and below ground (for soil health and the root system) that is required to protect trees and preserve tree health. This area has been identified as the **critical root zone (CRZ)** or **tree protection zone (TPZ)** by various experts and is generally agreed to be equivalent to the *soil area below ground and the space above ground defined by the tree's dripline*, or the greatest extent of the branches. This is depicted in Figure 1. However, for small trees, newly planted trees, and trees with narrow crowns, the dripline defines an area that is too small for proper protection.

So it is best to define both the critical root and tree protection zones as the circular area above and below ground with a radius equivalent to the greater of 6 feet or 1.5 feet for every inch in trunk diameter at 4.5 feet above the ground.

Both concepts--critical root zone and tree protection zone--are used throughout the remainder of this Guide. TPZ is more often used when talking about tree protection. The minimum requirements requirement for the amount of open soil surface area by tree canopy size category are listed below:

Very Small Canopy: 25 square feet (5 x 5 feet)
Small Canopy: 100 square feet (10 x 10 feet)
Medium Canopy: 225 square feet (15 x 15 feet)
Large Canopy: 400 square feet (20 x 20 feet) Larger areas are recommended wherever possible.

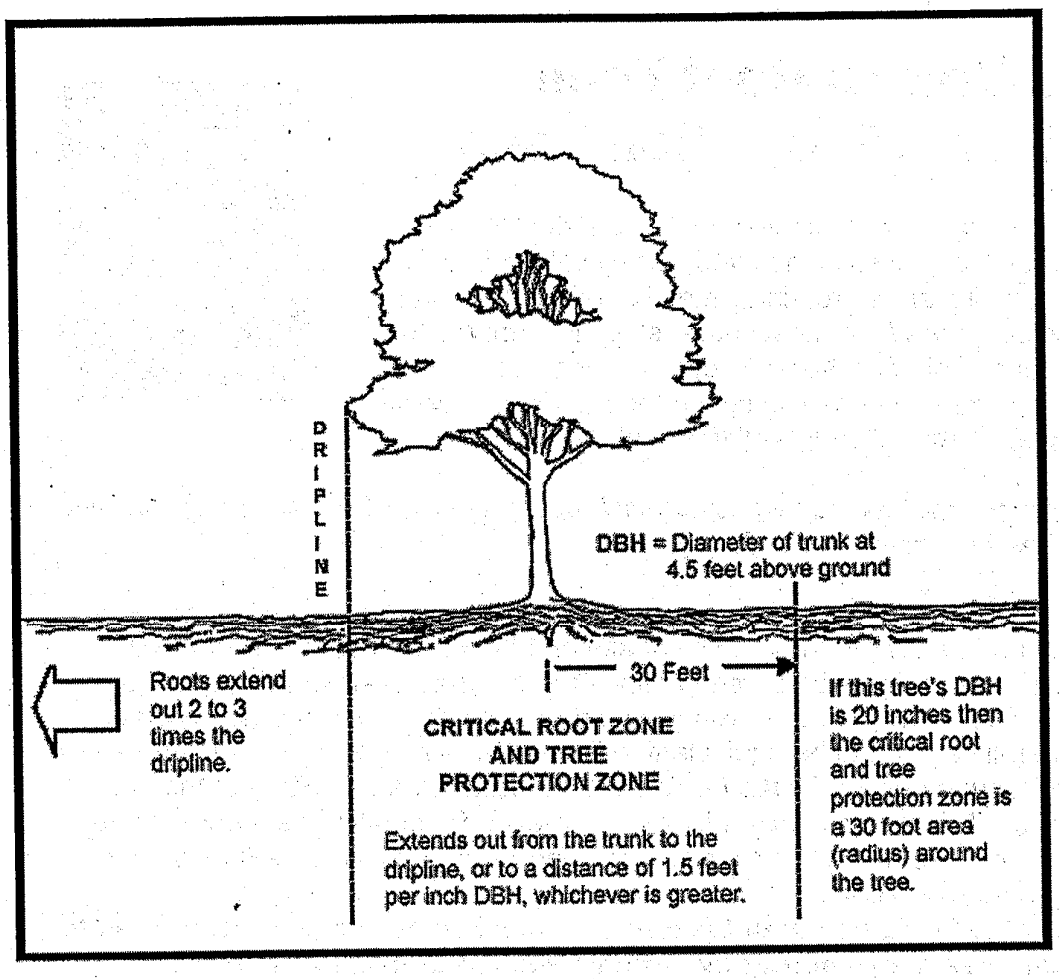


Figure 1. Location of the Critical Root Zone and Tree Protection Zone

Section 2: Best Management Practices for Tree Selection and Placement

Throughout Dade County there are a number of site situations that have unique characteristics important to the establishment and prolonged health of trees. Selecting a well-structured, healthy tree as defined in the Florida Department of Agriculture's **Grades and Standards for Nursery Plants**, as "Florida Fancy" or Florida #1" [Florida Statues Section 581.031 (1955)] will contribute to the tree's establishment and prolonged health. Site selection is equally important in the tree's future viability. For example, placing trees that thrive in wet conditions in arid locations does not contribute to prolonged health and vigor. In each situation, if trees are well selected and placed, they will provide recognizable, tangible benefits to the property owner and community.

Tree Species Selection

Tree selection is an important part of tree conservation and planting. Native species, together with a few proven non-native species are listed in the Tree Species List located on the following pages. The recommended trees included in the list are the choices of local and regional experts. These species form a broad palette of trees for use in our landscapes. Some of the important species characteristics and growth requirements that should be considered when making tree management decisions are included in the attached Tree List.

The ***benefits*** of knowledgeable tree selection include:

- ★ **a healthy environment with abundant tree canopy**
- ★ **reduced tree maintenance with better species to site match**
- ★ **diversity of species promoting forest stability**
- ★ **varied and interesting landscape**

Some ***common mistake***s made when selecting trees to conserve or plant include:

- × **reliance on non-native tree species**
- × **reliance on a few popular species which are over planted**
- × **incorrect species to site match**
- × **small trees selected and planted where large growing spaces exist**

Best Management Practices for Tree Species Selection

1. Plant and conserve good quality native trees wherever possible.
2. Plant large canopy trees wherever adequate space exists.
3. Maintain species diversity by conserving and planting a variety of tree species.
4. Plant no more than 10% of all trees in a given area with a single species.
5. Evaluate your site conditions—sunlight, soil pH, nutrient availability, soil moisture, and growing space--and select species for planting whose requirements match those conditions.
6. Select species that will best provide the function desired on the site (i.e. use non-deciduous trees for buffering and screening).

Recommended Street Trees for Right-of-Way Plantings

Scientific Name	Common Name	Height Range	Tree Size	Tree Type	Growth Rate	Special Needs
Acer rubrum	Red Maple	30' – 40'	Larger	Native	Fast	Wet areas
Amyris elemifera	Torchwood	10' – 15'	Small	Native	Slow	
Bourreria ovata	Rough Strong Bark	15' – 20'	Small	Native	Moderate	
Bulnesia arborea	Vera Wood	30' – 35'	Large	Flowering	Moderate	
Caesalpinia mexicana	Mexican Cassia	20' – 25'	Small	Flowering	Moderate	
Canella winterana	Wild Cinnamon Bark	20' – 30'	Small	Native	Slow	
Cassia fistula	Golden Shower	30' – 40'	Large	Flowering	Fast	
Cassia surattensis	Glaucous Cassia	10' – 20'	Small	Flowering	Fast	
Celtis laevigata	Sugarberry	40' – 60'	Large	Native	Moderate	
Chrysophyllum oliviforme	Satinleaf	20' - 60'	Small	Native	Slow	Wet and/or shady areas
Coccoloba diversifolia	Pigeon Plum	25' – 30'	Small	Native	Moderate	
Coccoloba uvifera	Sea Grape	15' – 30'	Large	Native	Moderate	Salt tolerate
Colvillea racemosa	Colville's Glory	40' – 50'	Large	Flowering	Moderate	
Conocarpus erectus	Green Buttonwood	30' –50'	Large	Native	Moderate	Salt tolerate
Cordia boissieri	White Cordia	15' – 20'	Small	Flowering	Moderate	
Cordia sebestena	Geiger Tree	20' – 25'	Small	Flowering	Moderate	
Drypetes laterfolia	Guinea plum	20' - 30"	Small	Native	Slow	
Exothea paniculata	Inkwood	35'	Large	Native	Moderate	
Ficus citrifolia	Shortleaf Fig	40' – 50'	Large	Native	Fast	
Ilex cassine	Dahoon Holly	20' –40'	Large	Native	Moderate	Wet areas
Ilex krugiana	Krug's Holly	25' – 30'	Small	Native	Moderate	
Jacaranda mimosifolia	Jacaranda	40' – 50'	Large	Flowering	Fast	
Krugiodendron ferreum	Black Ironwood	20' – 30'	Small	Native	Slow	
Lagerstroemia speciosa	Queen's Crape Myrtle	30' – 45'	Large	Flowering	Moderate	
Laguncularia racemosa	White Mangrove	40' – 60'	Large	Native	Moderate	Salt tolerate
Lonchocarpus violaceous	Lancepod	30' –35'	Large	Flowering	Fast	
Lysiloma latisiliqua	Wild Tamarind	40' –50'	Large	Native	Fast	
Nectandra coriacea	Lancewood	25' – 35'	Large	Native	Moderate	
Noronhia emarginata	Madagascar Olive	20' – 30'	Small	Shade	Moderate	Salt tolerate
Peltophorum pterocarpum	Copperpod	40" – 50"	Large	Flowering	Fast	
Persea borbonia	Red Bay	50' – 60'	Large	Native	Moderate	Wet areas
Pimenta dioica	Allspice	15' – 30'	Small	Shade	Slow	
Piscidia piscipula	Jamaica Dogwood	35' – 50'	Large	Native/ Flowering	Fast	
Podocarpus sp.	Podocarpus	30' –50"	Large	Shade	Moderate	
Prunus myrtifolia	West Indian Cherry	30' – 40'	Small	Native	Fast	
Quercus virginiana	Live Oak	40' – 50'	Large	Native	Moderate	
Simarouba glauca	Paradise Tree	35' – 50'	Large	Native	Moderate	
Swietenia mahagoni	Mahogany	35' –60'	Large	Native	Fast	

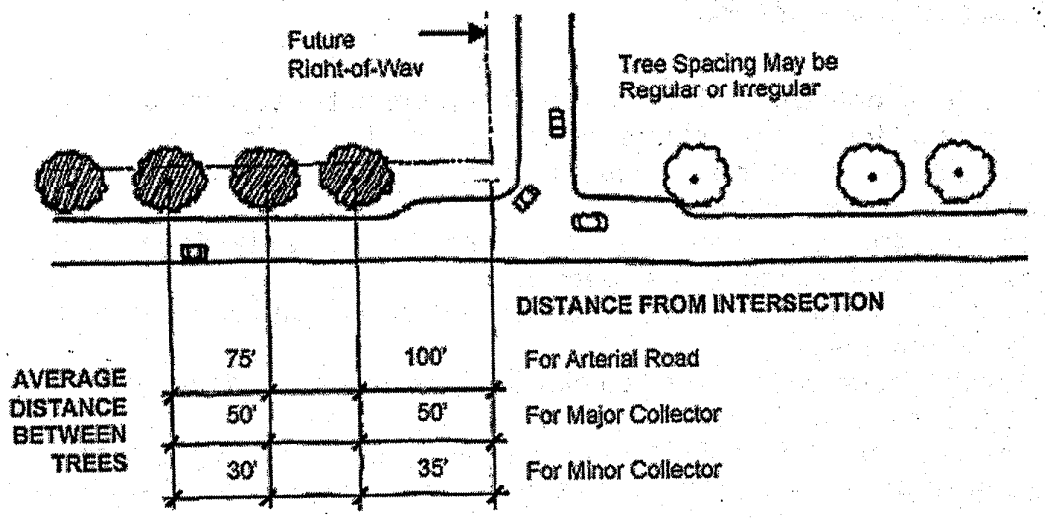
List revised from the Comprehensive plant list of the Miami-Dade County Landscape Manual. Palm species are not included in the street tree list because the Street Tree Master Plan recommends minimal usage for accent purposes only. Palms are monocots, similar to grasses or lilies. Shade trees are dicots, which provide numerous environmental benefits to the urban community.

Best Management Practices for Road Frontage Areas

1. Plant trees only where there is adequate room both overhead and underground for the mature size of the tree you are planting.
2. Vary the spacing of trees along road right-of-ways to add interest and diversity to roadway plantings.
Select trees from the recommended list for right-of-way planting to avoid nuisance or high maintenance species.
3. Maintain sight lines so drivers can see pedestrians and vehicles when pulling out of driveways.
4. Provide clearance for large vehicles such as buses and delivery along tree lined streets and drives.
5. Provide at least 8 feet of clearance for pedestrians and bicyclists to avoid hazards created by low branches or trees too close to sidewalks and drives.
6. Consider the impact of utility line maintenance along roadways and canal maintenance activities along canals.
7. Avoid over-thinning a natural stand to reduce susceptibility to wind damage and uprooting.
8. Remember that the closer you plant a tree to the street in a frontage area, the more difficult the situation for healthy tree growth.
9. Tunnel or bore instead of trenching during utility line installation to avoid damaging tree roots.
10. Plant trees a minimum of 15 feet from driveways and 35 feet from road intersections for minor collectors, 50 feet for major collectors, and 100 feet for arterials.
11. Avoid planting trees directly over property lines or corners.
12. Tree lawns—the planting area between the sidewalk and curb—should be a minimum of 4 feet wide.
13. Consider the installation of root barriers along sidewalks and curbs to prevent tree roots from heaving and breaking pavers, sidewalks, curbs, and road pavement.
14. Plant trees behind the sidewalk utilizing private property and tree planting easements, to increase above and below ground growing space and vehicular and pedestrian clearance.

Design Standards for Road Frontage Areas

MINIMUM STREET TREE SPACING AND DISTANCE FROM INTERSECTION



Arterials and Collector Roadways:
These highways, also referred to as surface streets, are comprised of highways with at-grade intersections. Normally, these roadways have narrow, if any, shoulders, narrower lanes than freeways, and have obstacles both vertically and horizontally adjacent. In most cases, control of the flow is by means of traffic signals, and thereby, the per lane capacity of the roadway is less than that of an expressway. Collectors feed into arterials.

Section 3: Best Management Practices for Tree Care

Regardless of where trees are located in our landscapes, all trees require some level of care. This level of care generally increases as our interaction with the tree and our impact upon the tree increases. Trees in urban environments require a high level of care, since our interaction with them is frequent. The following section addresses basic tree
care activities.

Soil Health Maintenance

is the preservation of natural soil conditions that are conducive to plant growth. Preserving *soil* health is essential to preserving tree *root* health, which in turn promotes *whole tree* health. While it seems that some trees will grow anywhere, most trees are particular about the soil conditions under which they will thrive.

Soil consists of basic components--mineral matter, organic matter, soil organisms, and pore spaces that hold water and oxygen. Both the texture of the soil (relative components of sand, clay, and loam) and the structure of the soil (arrangement of soil particles) are important factors in determining how much water and oxygen a soil can hold.

Soil fertility is also important, and can be evaluated using standard tests that measure the amount of phosphorous, potassium, calcium, magnesium, zinc, and manganese in the soil. The availability of these elements is affected by soil pH and organic matter content. Soil tests can determine the soil pH (acidity/alkalinity) and the amount of organic matter present by weight. The Cooperative Extension Service may provide free soil sampling advice and soil sample analyses for a nominal fee.

Soil moisture levels also affect the health of a tree (see "Tree Selection and Placement"). Refer to Recommended Street Trees for Right-of-Way Plantings list for specific information on which species thrive in wet conditions and which do well in dry conditions.

Maintaining soil health and adequate soil volume provides the following ***benefits***:

- ★ **improved tree survival, growth, and longevity**
- ★ **maintenance of structural integrity of the root system and reduction in the probability of whole tree failure**
- ★ **allows for root development without intrusion of roots into sewer lines**
- ★ **reduced soil erosion and improved water quality**

To maintain healthy soil and tree roots avoid these ***common mistakes*** within (and as far as possible beyond) the tree's critical root zone (CRZ):

- × **compacting soil with foot, vehicle, and equipment traffic and materials storage**
- × **cutting roots by trenching for utility line installation or repair**
- × **grade changes, including cuts and fills**
- × **change in water drainage patterns and water levels**
- × **removal of topsoil without replacement**
- × **soil contamination from equipment washouts, vehicle and lawn maintenance chemicals**
- × **lack of adequate soil volume within and around hardscapes such as tree wells, plazas, and parking lots**

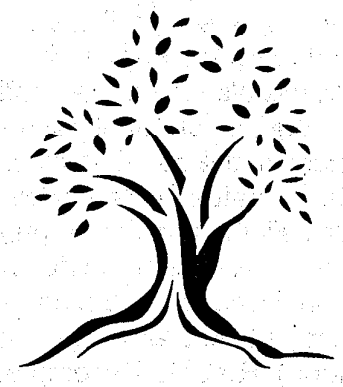
- × **fertilization without testing**
- × **heavy applications of fertilizer**
- × **heavy applications of weed and feed products to turf within the root zones of trees**

Trees require adequate volumes of soil in which their roots can expand, allowing for tree growth.

It is very important to recognize that a tree's requirement for growing space and soil rooting volume increases as tree age and size increases. At the time they are planted, trees should be provided with enough growing space for their future, mature size.

If adequate soil volumes are not available throughout a tree's life, then much more intensive management is required and the tree will be reduced in size, condition, and useful life span.

Tree Establishment



consists of a series of steps that begins with the development of a planting plan designed to meet the objectives of the property owner or the requirements of local development regulations. Once a plan is developed, the establishment process continues with the selection of planting sites and appropriate species. The sites are prepared, trees are purchased and planted, new tree maintenance begins, and regular maintenance continues for at least 3 years, completing the establishment process. New trees should be planted on a regular basis--to replace trees that are removed, to add to an existing group of trees, and to insure that our community forest remains diverse, dynamic, and stable.

The ***benefits*** of regular and successful tree establishment are:

- ★ **stable tree population with a diversity of ages, sizes, and species**
- ★ **maintenance of tree canopy cover for future generations**
- ★ **opportunities for community involvement in tree planting and maintenance activities**
- ★ **better survival and lower tree establishment costs**

Common mistakes made in tree establishment include:

- × **not enough growing space provided and the tree grows too large for the available space inadequate soil volume provided with restricted root growth and decreased tree stability**
- × **species planted does not meets the site conditions of available growing space, soil moisture and pH, sunlight, temperature, or general climate**

- × poor quality planting stock (i.e "Florida #2" and/ or "Cull") is selected, most often with co-dominant leaders (forked stems) or inadequate root systems tree is planted in a hole that is too small
- × tree is planted too deep, below ground level
- × regular after-planting care is not provided during the 3-year establishment period
- × trees are staked unnecessarily
- × tree watering rings remain in place longer than 1 year
- × stakes and guy wires are incorrectly placed or left on longer than 1 year

Best Management Practices for Tree Establishment

Tree Selection

1.Select a tree from the approved Right-of-Way Tree List.
2. Select a tree of appropriate size (at maturity) for the site.
3. Select native tree species for planting if they are available and where they match the site conditions, instead of non-native species.
4. Use proven, non-native species for special purposes or difficult situations.
5. Select only good quality planting stock, trees with a good quality root system, a straight trunk without wounds, a single, central leader (no "forked" stems), and a full, well-balanced crown.
6. Select trees that meet the minimum standards for root ball size and quality as defined in the American Standards for Nursery Stock.
7. Protect trees from wind damage during transport by covering with a tarp or landscape fabric.

Site Selection

8. Place trees where they have plenty of room to grow to maturity without their health or form being compromised by conflicts with infrastructure.
9. Provide trees with an adequate amount of soil volume for tree growth and stability.
10. Make sure there is now and will be at tree maturity adequate clearance from overhead utility lines, pedestrian and vehicular traffic, buildings, signs, and street lights.
11. Plant at least 10 feet from an underground utility line.
12. Plant only small maturing trees within 10 feet of an overhead utility line.

Site Preparation

13. ALWAYS call the *Utilities Protection Center at 1-800- 432-4770* for utility locations before you dig to install trees.
14. Till, harrow, or break up compacted soils in an area 5 to 10 times the width of the new tree's root ball or container.
15. Dig a planting hole that is at least 2 times and as much as 5 times the width of the new tree's root ball or container.
16. Dig the planting hole no deeper than the height of the new tree's root ball.
17. Do not add soil amendments such as peat moss or fertilizer to the planting hole.

Tree Planting

18. Move the tree using only the root ball or container; avoid using the tree trunk as a "handle" to move trees, which can break tree roots and damage the trunk.
19. Plant the root ball at or slightly above ground level, never below.
20. Remove all tags, wires, string, straps, burlap, and wire baskets from the root ball.
21. Backfill the planting hole with the original soil.
22. Do not add fertilizer or other soil amendments to the planting hole.
23. Water once when the planting hole is halfway full of soil, and again thoroughly when full to eliminate air pockets.
24. Do not create a watering ring around the tree unless soil conditions are very dry; remove rings after one year.
25. Always remove stakes and guy wires after 1 year.

New Tree Maintenance

26. Mulch newly planted trees with leaves, pine straw, or other organic materials to 3-4" in depth and in a 5-foot radius around the tree, or as wide as possible; keep the mulch at least 5 inches from the tree trunk.
27. Prune only dead, broken, crossed, or rubbing branches; prune annually thereafter.
28. Water in the amount of 1" per week in the absence of adequate rainfall.
29. Establish tree protection zones (TPZs) around new trees during construction activities.
30. Inspect newly planted trees regularly to evaluate their condition and maintenance needs.
31. Remove tree watering rings after one year.
32. Remove stakes and guy wires after one year.

Proper tree planting is essential to long-term tree survival and health. Figure 2 shows the recommended method for planting a tree.

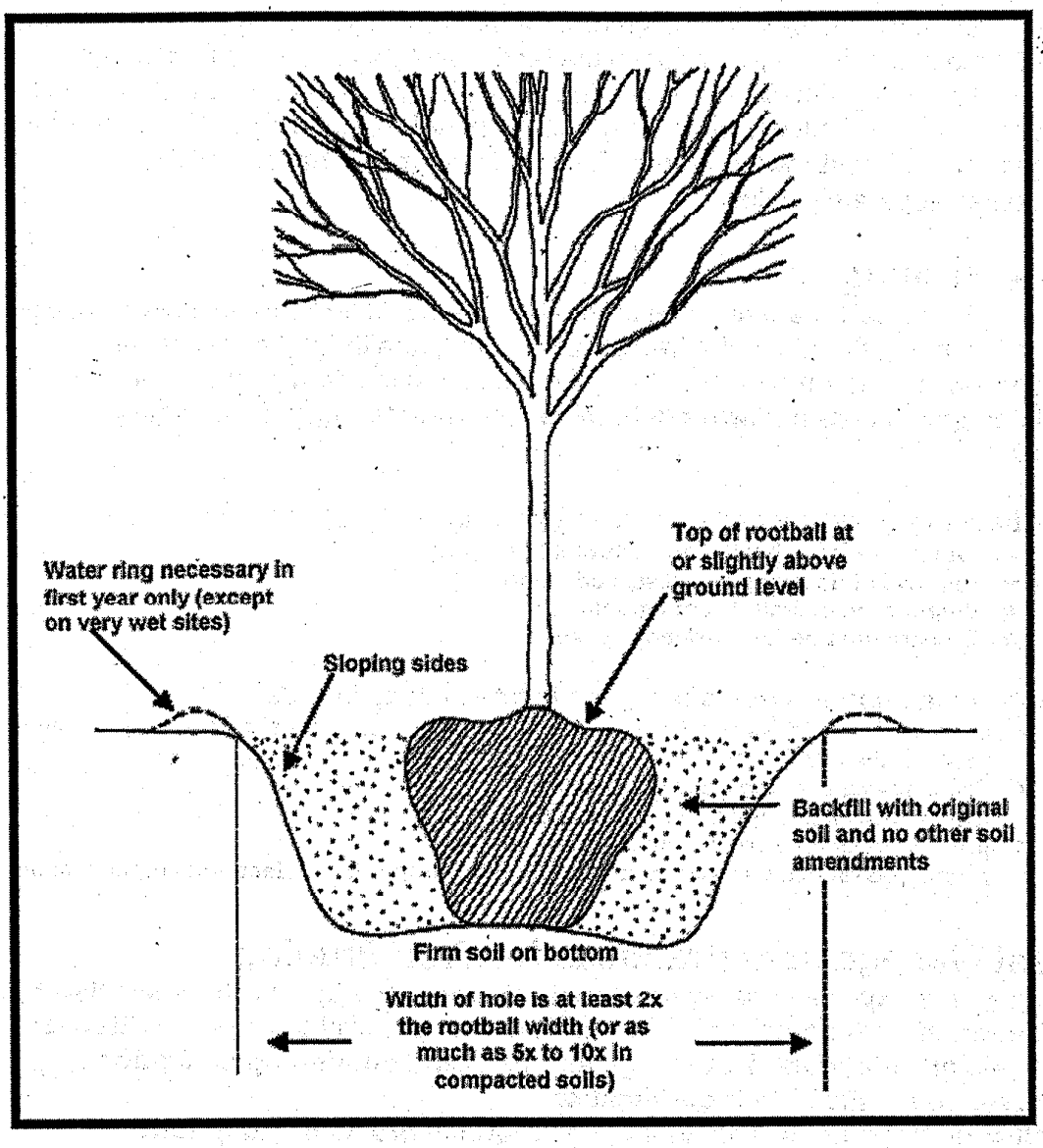


Figure 2. Recommended Tree Planting Method

Tree Maintenance

The routine care given to a tree throughout its life will preserve or improve its health, function, and safety. The amount of maintenance a tree requires depends on the species, the tree's location in the landscape, its age, and the care (or abuse) it's been given. Basic tree maintenance begins with regular inspections to determine a tree's needs, which may include **pruning, mulching, fertilization, irrigation**, and **pest management**. Each of these maintenance activities is discussed separately below.

Tree Pruning

Pruning is the deliberate removal of tree branches and limbs to achieve a specific objective in the alteration of a tree's size, spread, health, and form. Regular inspections to determine a tree's pruning needs should be a part of every tree maintenance program. Always determine your objective before beginning pruning.

The ***benefits*** of regular and correct tree pruning are:

- ★ **better tree form, health, and structural integrity**
- ★ **removal of decaying and diseased wood**
- ★ **decrease in overall risk of limb failure**
- ★ **prepare the tree for hurricane season**

Some of the ***common mistakes*** made in tree pruning include:

- × **improper techniques such as topping, stub cuts, flush cuts, and stripping the bark beneath the pruning cuts**
- × **using spikes to climb trees for pruning**
- × **waiting until limbs get large to prune them**
- × **pruning trees on a crisis only basis**
- × **pruning to reduce tree size as a substitute for proper tree selection and placement**

Best Management Practices for Tree Pruning

1. Hire only experienced professionals to prune trees; arborists certified by the International Society of Arboriculture are required to pass a written test of basic arboricultural knowledge and to attend continuing education courses to maintain their certification.
2. NEVER "top" trees. This is an unacceptable practice and greatly decreases tree health, safety, and longevity.
3. NEVER use climbing spikes or spurs while pruning trees, except during an emergency rescue.
4. Trees should be inspected before climbing to determine the amount and extent of hazards, and the tree owner should be notified of potentially hazardous or harmful conditions.
5. Keep pruning equipment sharp, clean, and in good operating condition.
6. When pruning limbs that show evidence of disease, clean pruning equipment
between trees.

7. Always prune trees back to the parent branch or a lateral that is at least 1/3rd the diameter of the branch being pruned.
8. Prune just outside of the branch collar.
9. At time of planting, prune only to remove dead, broken, crossed, or rubbing branches.
10. Prune trees when young to develop branch structure, strength, and form.
11. Prune off one of two leaders on trees with co-dominant (forked) stems.
12. Prune trees regularly throughout their life to maintain vehicular, pedestrian, and sight clearance, and to remove deadwood and broken branches.
13. Make proper pruning cuts using the 3-cut method, avoiding stub cuts, flush cuts, and wounds to remaining limbs and trunk (see Figure 3).
14. Do not remove more than 1/4th of the foliage of a mature tree in any one growing season.
15. Do not remove more than 1/3rd of the foliage of a young tree in any one growing season.
16. Do not remove more than 1/4th of the foliage from a branch unless you are removing the entire branch.
17. When pruning for hurricane preparedness, thin the crown by removing selected branches to decrease wind resistance.
18. Always wear personal protective safety equipment while pruning, including safety glasses.
19. NEVER prune (or remove) trees located near energized electrical service or other utility lines; to have a tree growing beneath utility lines pruned or removed, contact your utility service provider.
20. Talk to your utility provider about their needs for clearance and their pruning techniques designed to maintain that clearance.
21. Employ natural target pruning and crown reduction pruning when pruning trees for line clearance instead of "topping"

A recommended method commonly employed to safely remove large tree limbs is illustrated in Figure 3 (see following page).

When removing a branch, make your cut back to the trunk or parent limb, just outside the branch collar, at an approximately 45degree angle to the branch bark ridge. In Figure 3, Cut 1 is made first, then Cut 2 is made just outside of Cut 1. At this time the majority of the branch begins to fall, breaks at Cut 1, and is removed without stripping the bark below Cut 1. Cut 3 is then made just outside the branch collar or swelling at the base of the branch and the remainder of the branch or limb is removed.

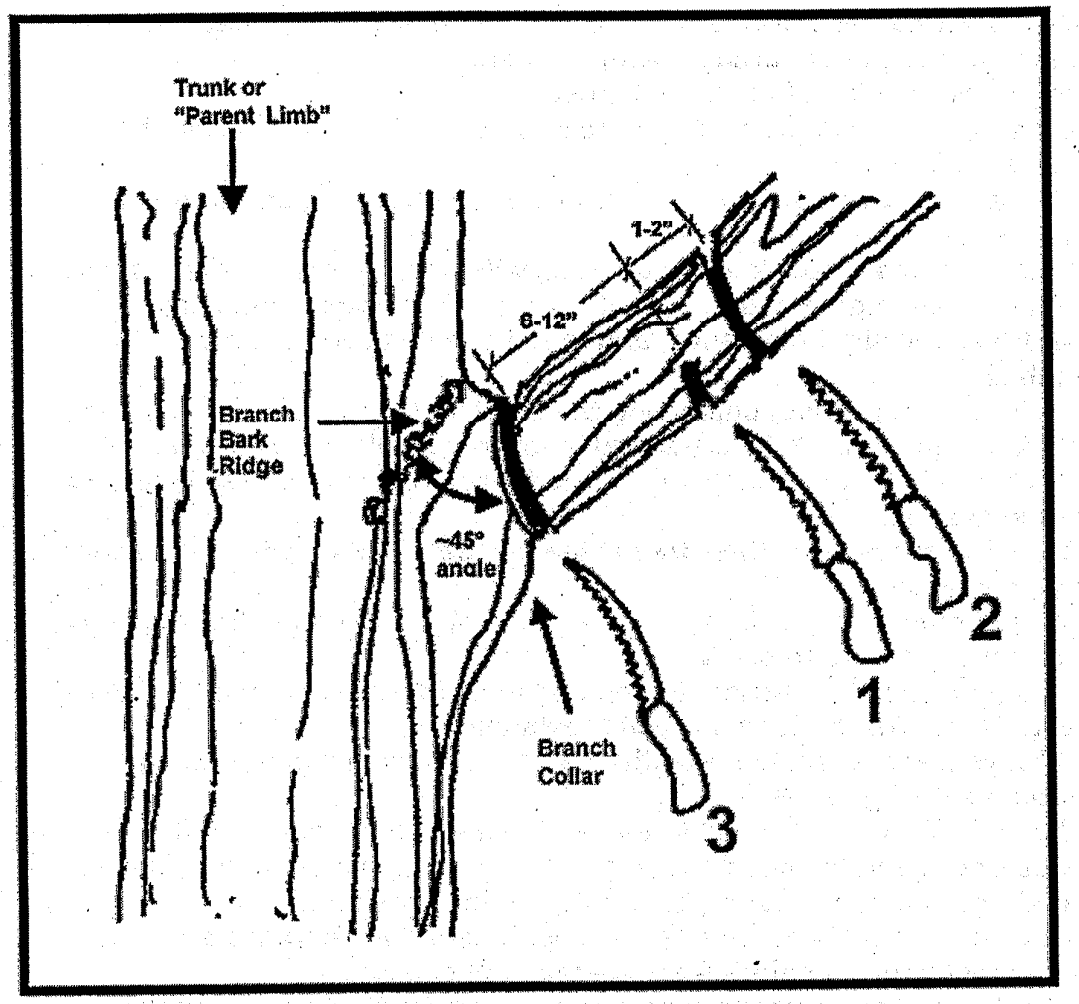


Figure 3. The 3-Cut Pruning Method

Tree Mulching

Mulching is the application of organic material on top of the ground over a tree's root system to improve soil moisture and fertility and to enhance root and tree growth. The objective in mulching is to recreate the conditions found in undisturbed, natural woodlands.

Mulching provides ***benefits*** to trees because it:

- ★ **retains soil moisture**
- ★ **moderates soil temperatures**
- ★ **suppresses weed growth**
- ★ **improves soil fertility and structure over time**
- ★ **recreates the natural conditions under which trees grow in the forest, conditions which includes a thick layer of leaves and composted organic matter**
- ★ **eliminates the need for mowing and weed trimming around the base of trees**

When mulching, these ***common mistakes*** are often made:

- × **lack of regular mulch applications**

- × mulch ring is much too small and covers very little of the root zone of the tree
- × mulch is piled up in a "volcano" fashion around the tree trunk
- × mulch is touching the tree trunk
- × black plastic, pine bark, or other impermeable materials are used for "mulch"
- × string weed trimmers are used to cut weeds within mulch beds, often damaging tree trunks in the process

Best Management Practices for Tree Mulching

1. Use organic materials such as pine straw, leaves, aged wood chips, and compost; avoid grass clippings, pine bark, plastic, and rocks.

2. For newly planted trees, mulch an area at least six feet around the tree.

3. For established trees, mulch out to the dripline or as far out as practical.

4. Spread mulch in an even layer, 3-4" deep; avoid mounding the mulch around the tree trunk.

5. Keep mulch at least 5 inches from the tree trunk to avoid creating favorable places for pests.

6. Mulch twice per year, in the late spring and in fall during leaf fall.

7. Use a tree's own leaves for mulch.

8. Avoid using string weed trimmers around the base of trees to remove weeds within mulch beds; hand pull weeds or use a contact herbicide to kill weeds.

As simple as mulching can be, if done improperly it can cause problems for the tree such as insect, disease, and rodent damage, or a decrease in soil aeration or moisture.
Use Figure 4 (following page) as a guide for recommended mulching methods .

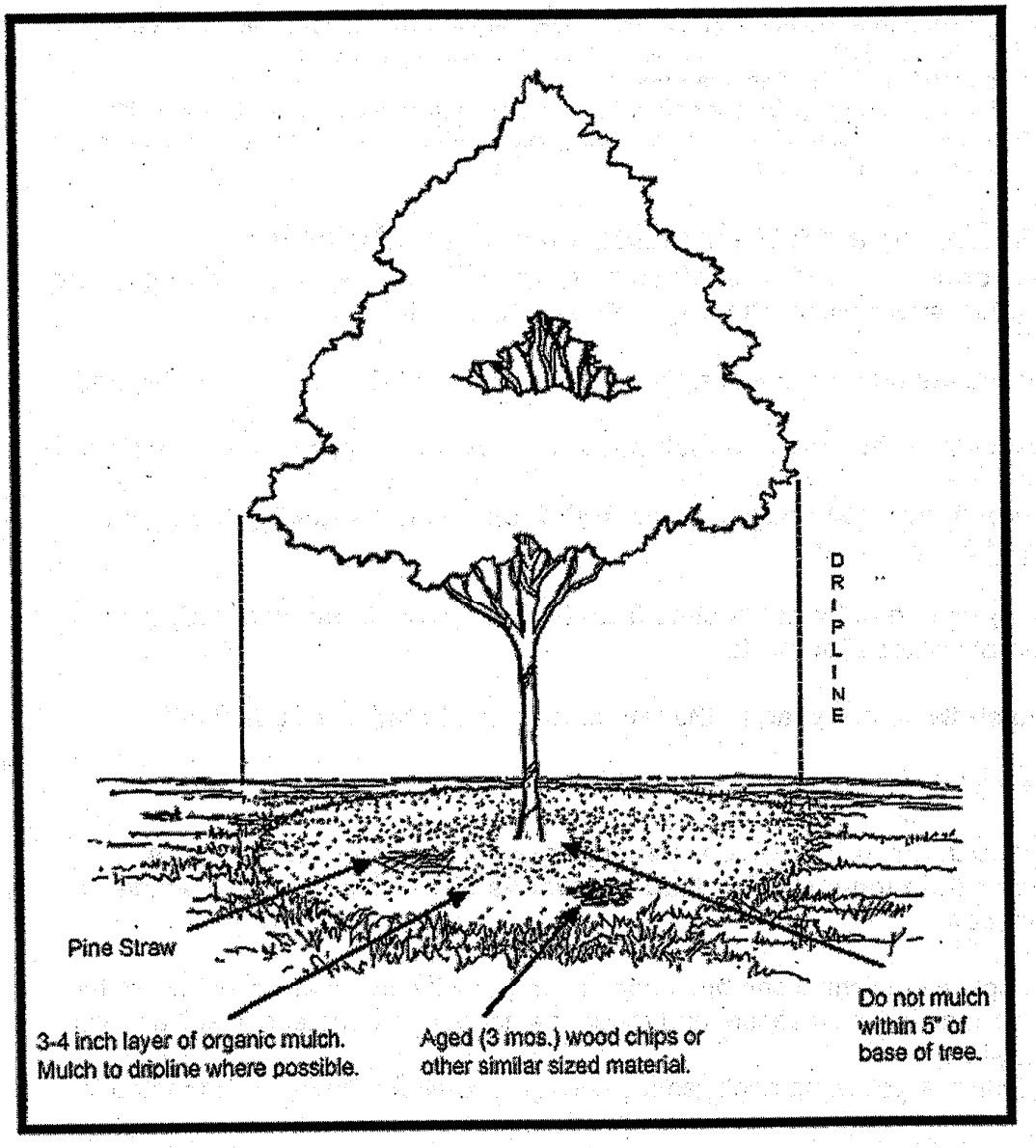


Figure 4. Recommended Method for Tree Mulching

Tree Fertilization

Fertilization is the application of nutrients to the soil or plant leaves to enhance growth. It should only be done for a specific purpose or to correct a specific deficiency discovered through soil testing or foliar analysis. The Cooperative Extension Service (305-248-3311) may provide fertilization advice and soil sample analysis, as do private laboratories.

The ***benefits*** of fertilization include:

- ★ **healthier, more extensive root systems**
- ★ **increased growth and larger trees at an earlier age**
- ★ **healthier tree in better condition to defend itself against pests**

To enhance tree growth through fertilization, avoid these ***common mistakes***:

- × **fertilization without knowledge of nutrient availability and deficiencies**
- × **over fertilization, either too much at one time, or too often**
- × **use of weed and feed fertilizers beneath trees**

Best Management Practices for Tree Fertilization

1. Apply fertilizer based upon recommendations resulting from a soil test to address known deficiencies.
2. Do not apply fertilizer to newly planted, drought stressed, or severely wounded or injured trees.
3. Apply fertilizer when the roots are actively growing; late winter, early spring, and early summer are the best times to fertilize.
4. Use an NPK fertilizer ratio of 3:1:1 or 3:1:2 in the absence of a recent soil test.
5. Use slow release organic fertilizers with a salt index of less than 50.
6. Apply slow release fertilizers to trees at a rate between 2 and 4 pounds of nitrogen per 1000 ft_2 of root area.
7. Apply fertilizer to the CRZ of trees, from the trunk to the dripline, but only once to overlapping root zones.
8. Do not use fertilizer injections and implants into the trunk for routine fertilization.

The amount of fertilizer that should be applied to achieve recommended nitrogen fertilization rates is listed in Table 1.

N-P-K	Pounds of Fertilizer to Apply Per 1000 Sq Ft to Achieve a Rate of		
Fertilizer Formulation	2.0 lbs of N	3.0 lbs of N	4.0 lbs of N
5-X-X	40.0	60.0	80.0
10-X-X	20.0	30.0	40.0
15-X-X	13.3	20.0	26.7
20-X-X	10.0	15.0	20.0
30-X-X	6.7	10.0	13.3

Tree Irrigation

Irrigation involves the regular application of water to the root systems of a tree in the CRZ to supplement rainfall. Water is essential to tree growth, the absorption of elements and nutrients, and the production of food energy. Irrigation may be done simply using a hose, sprinkler, or bucket, or may be accomplished with a large capacity water tank or installed irrigation system.
Irrigation provides ***benefits*** such as:

- ★ **better tree growth with fewer periods of stress and less susceptibility to insect and disease infestation**
- ★ **better tree survival, less replanting, more economical tree establishment costs**

- ★ **requires visits to the tree which can also serve as a time for regular tree inspections**

When watering trees, avoid these ***common mistakes***:

- × **newly planted or damaged trees are not watered regularly during hot and dry periods**
- × **too little water is applied during each irrigation period, or water runs off and does not penetrate the soil**
- × **small amounts of water are applied too often, encouraging shallow rooting**
- × **trees are watered too much and too frequently, keeping roots and soil "waterlogged"**
- × **tree trunks are "watered" and remain wet for prolonged periods of time**
- × **watering rings created at planting are not removed after one year**

Best Management Practices for Tree Irrigation

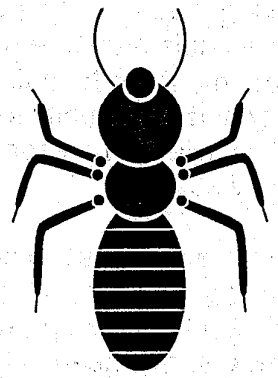
1. Plant trees at or slightly above ground level to avoid creating a place where excessive water accumulates.
2. Match tree species to soil moisture conditions, utilizing upland and drought resistant trees where soil moisture is typically low, and lowland and flood tolerant species where soil moisture is typically high or where the site is frequently flooded.
3. Mulch trees to conserve water.
4. Water trees before they show signs of water stress.
5. In the absence of adequate rainfall, apply 1 inch of water per week during the growing season throughout the root zone of newly planted trees, damaged trees, or trees under stress.
6. Water during the hours of 10 p.m. to 8 a.m.
7. Water less often with greater amounts of water rather than more often with smaller amounts of water.
8. Apply water evenly throughout the outermost 75% of the CRZ.
9. Apply water slowly to avoid runoff outside of the CRZ.

The amount of water required for a tree depends upon its age, trunk diameter, and the size of its root zone. To determine the amount of water to apply to your tree's root zone, first calculate the radius of the CRZ. Then, calculate the number of seconds it takes you to fill a 5-gallon bucket of water with the hose or water delivery system you are using. Match that time to the closest number of seconds listed in Table 6 and to the radius of your CRZ to find the total application time required to water your tree. These numbers assume that you are watering the outermost 75% of the CRZ.

Table 6. Approximate Watering Time to Apply One Inch of Water Across Various Sized Critical Root Zones

Radius of CRZ (ft)	Volume of Water (gals) to Equal 1"	Total Application Time (minutes and hours) at a Delivery Rate of 5 Gallons Per				
		5 Sec	15 Sec	30 Sec	45 Sec	60 Sec
5	37	1 min	2 min	4 min	6 min	7 min
10	147	3 min	7 min	15 min	22 min	30 min
15	330	6 min	17 min	33 min	50 min	1 hr
20	587	10 min	29 min	1 hr .	1 hr 30 min	2 hrs
25	917	15 min	46 min	1 hr 30 min	2 hr 30 min	3 hrs
30	1,322	22 min	1 hr	2 hrs	3 hr 30 min	4 hrs 30 min
35	1,799	30 min	1 hr 30 min	3 hrs	4 hr 30 min	6 hrs
40	2,349	39 min	2 hrs	4 hrs	6 hrs	8 hrs
45	2,973	50 min	1 hr 30 min	5 hrs	7 hrs 30 min	10 hrs
50	3,670	1 hr	3 hrs	6 hrs	9 hrs	12 hrs

Pest Management



Pest Management is the control of weeds, insects, fungi, bacteria, or other tree pests through a variety of techniques and at a level that meets your management objectives.
The best approach to pest management is an integrated one that utilizes prevention, biological controls, and--when warranted and absolutely necessary--chemical controls.
The ***benefits*** of timely pest management include:

- ★ **increase in knowledge of impact and life cycle of tree pests**
- ★ **reduction in the number of trees affected**
- ★ **increased tree health with timely pest identification and management**

Some ***common mistakes*** made in managing tree pests include:

- × **trees are planted that are highly susceptible to common pests**
- × **changes in tree condition and pest symptoms and signs are ignored**
- × **pest problems are allowed to reach catastrophic proportions before treatment is considered**
- × **pesticides are over-used or are selected as the first option**
- × **pesticides are applied at a stage when they are ineffective on or do not reach the pest**
- × **tree trunks are painted white to defend against insects (this is not effective)**

Best Management Practices for Pest Management

1. Plant trees where their needs will match the site conditions to prevent stress and predisposition of trees to pest attacks.
2. Mulch to relieve soil moisture stress and to suppress weeds; pull weeds *by hand* where necessary around the base of trees.

3. Protect tree roots, trunks, and limbs from wounds. Wounds are entry points for insects and diseases.
4. Learn the habits and life cycle of the pests affecting your trees, and know when to apply pesticides for the greatest effect.
5. Hire only experienced and knowledgeable professionals to apply pesticides6. Do not apply any soil active herbicides or weed-and-feed lawn formulations over the root systems of trees.
7. Contact the Cooperative Extension Service Commission for instructions on collecting insect and disease organisms or signs for analysis and identification.-

Tree Removal and Replacement

are activities that will have to occur for every tree at some point. The overall goals of tree removal and replacement are to maintain public safety and community forest health while also preserving tree canopy cover.

There are many reasons why trees must be removed. They may be growing in the wrong location, without adequate growing space, and are in conflict with hardscape (driveways, walkways, etc.) or other infrastructure (buildings, roadways, overhead utility lines). They may be old trees that are at the end of their normal life span. They may be dead or in poor or hazardous condition and require removal to protect the safety of the owner or the public in general. Whatever the reason for removal, the site should be evaluated to determine if another tree can be planted in the same or a nearby location to maintain tree canopy cover in the area.

The ***benefits*** of timely tree removal and replacement include:

- ✯ **reduced risk of failure with the prudent removal of trees**
- ✯ **reduced risk of pest infestations and damage to other trees**
- ✯ **additional space for new, vigorously growing trees**

Common mistakes made in tree management that cause tree removals include:

- × **trees are not provided with adequate space to grow to maturity**
- × **large maturing trees are planted beneath utility lines**
- × **trees are neglected and not routinely maintained tree preservation activities are undertaken only when a tree is in poor condition**
- × **trees in poor condition without reasonable chances for improvement or repair are left to fall apart instead of being removed**
- × **trees are planted that have a characteristic unsuitable for their location**

Best Management Practices for Tree Removal and Replacement

1. Have an experienced arborist evaluate tree health and risk for failure before removing old, large, landmark, or historic trees, or trees damaged in a storm to avoid unnecessary tree removal. Some species are able to be righted after a storm and survive for many more years.
2. Check with the Department of Environmental Resources Management (DERM) or your municipality regarding tree removal permitting requirements.
3. Hire only experienced professionals to remove trees.
4. Reduce the number and frequency of necessary tree removals through proper tree selection, placement, protection, and maintenance.
5. Evaluate trees at risk for failure using standard methods which include the assessment of the probability of failure, size of part that may fail, and the targets that may be affected should the tree fail.
6. Remove trees in irreversible health decline and poor condition.
7. Removes trees creating a hazardous situation that cannot be remedied with pruning, cabling and bracing, or removal of the target
8. Remove trees with characteristics in conflict with the site (tree with staining leaves planted in a parking lot).
9. Remove trees located where growing space is inadequate.
10. Remove trees with unattractive form, or messy, hazardous, or noxious flowers or fruit.
11. Replace trees wherever and whenever possible, planting large canopy trees if space permits.
12. Request that Florida Power and Light (*telephone #*) remove trees located near or beneath utility lines; do not attempt to remove these trees yourself.
13. To preserve landmark or historic trees with an increased risk of partial or whole tree failure as long as possible, consider removing the target by restricting public access or moving valuable structures.
14. Positively identify ownership before authorizing tree removal.

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